Chair of Lighting, University of Naples Federico II

International Conference

LED LIGHTING TODAY: TALES OR FACTS?

Toward an integral evaluation of Light Emitter Diodes as sources for general lighting purposes

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Universidad Nacional de Tucumán

REPUBLICA ARGENTINA

UNIVERSIDAD NACIONAL DE TUCUMÁN

Tucumán, República Argentina

…a wide view of the question is needed

AADL Asociación Argentina de Luminotecnia

www.aadl.org.ar

Lighting Standards

ADELCO LIGA DE ACCION DEL CONSUMIDOR

www.adelco.org.ar

Consumers Protection

LED Market today

- Domestic market are growing at an annual rate of 30% in Argentina
- The great market expectations for SSI, come from lighting designers and specialists.
- The information to consumers are mainly provided by manufacturer or Suppliers and in many cases, are unreliable.

LED Market today

- A wide range of products are now available

…which include disposable luminaires for outdoor lighting.





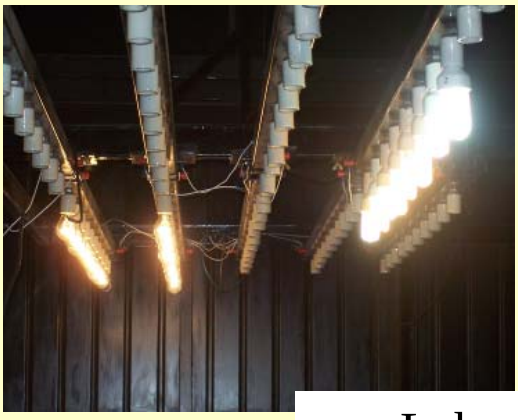




Products range (according to commercial information)

Feature	Mínimum	Máximum
Number of LED per unit (Nr.)	1 LED (high power LED: 3, 5,10 W)	1600 LED (street lighting luminaire)
Power range (W)	0,25 W (SMS LED-HB class III)	400 W (street lighting AP 1001)
Life range (h)	20.000 h	70.000 h
Light output range (lm)	50 lm	14.000 lm (street lighting AP 1001)
Efficiencyiy range (lm/W)	46,6 lm/W, (3x0,5W/70lm)	81,25 lm/W (20W/1600lm)
Price range (€)	3,6 €	650 €

Products can be grouped according by their similar features



Laboratory tests

Evaluation Criteria:

LED should be evaluated in the same extent that conventional lamps are evaluated, mainly:

- **Lumen efficiency**
- **Lumen depreciation**
- **Life and Endurance**
- **Colour quality and colour shift**
- **Environment impact**

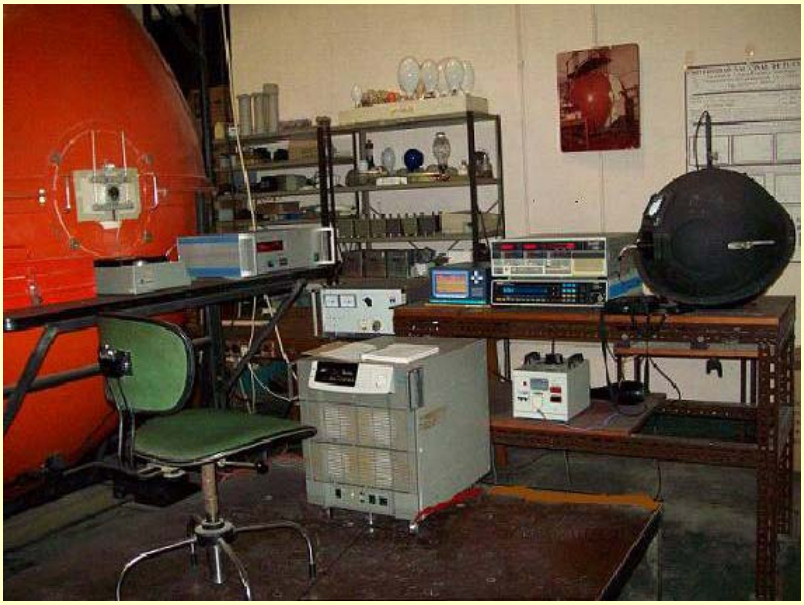
Lumen efficiency and depreciation

According to commercial information LED Efficiencyiy range from

	Minimum	**Maximum**
Efficiencyiy range of LEDs	**46,6 lm/W (3x0,5W/70lm)**	**81,25 lm/W (20W/1600lm)**

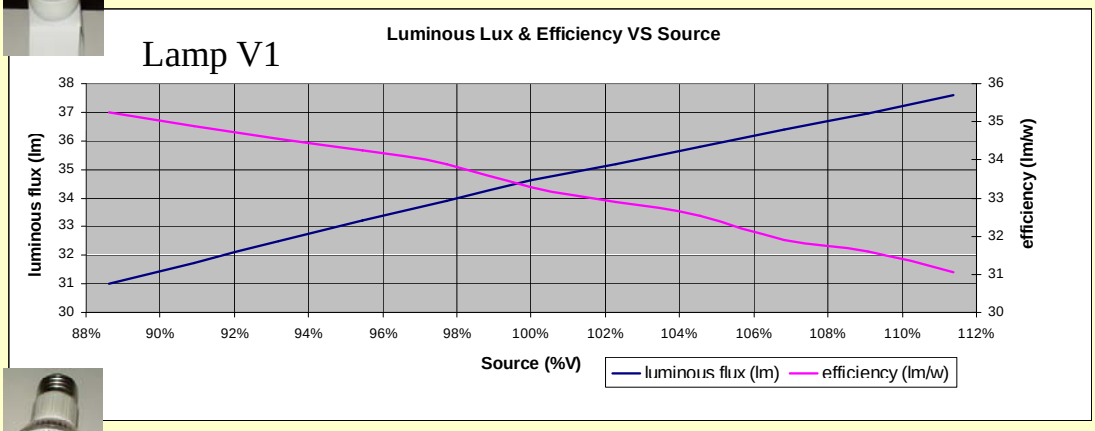
Efficiency in LED may drop drastically due to lumen output depreciation

Laboratory tests

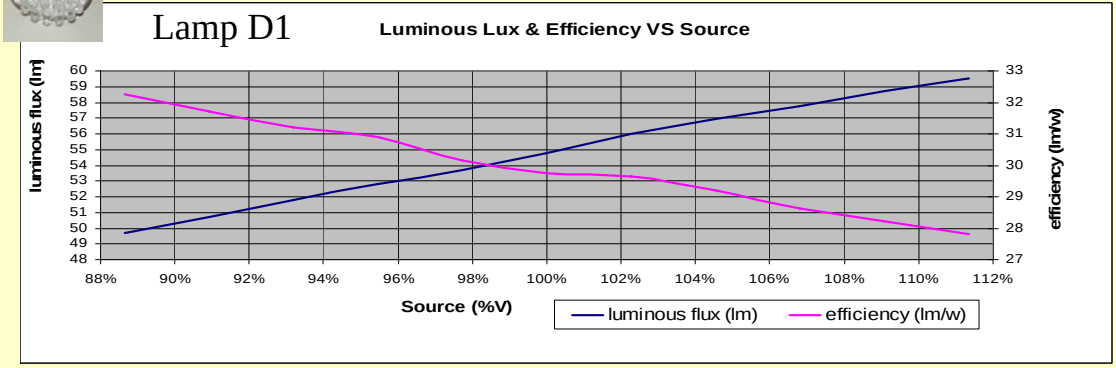


Efficiency depends of source voltage

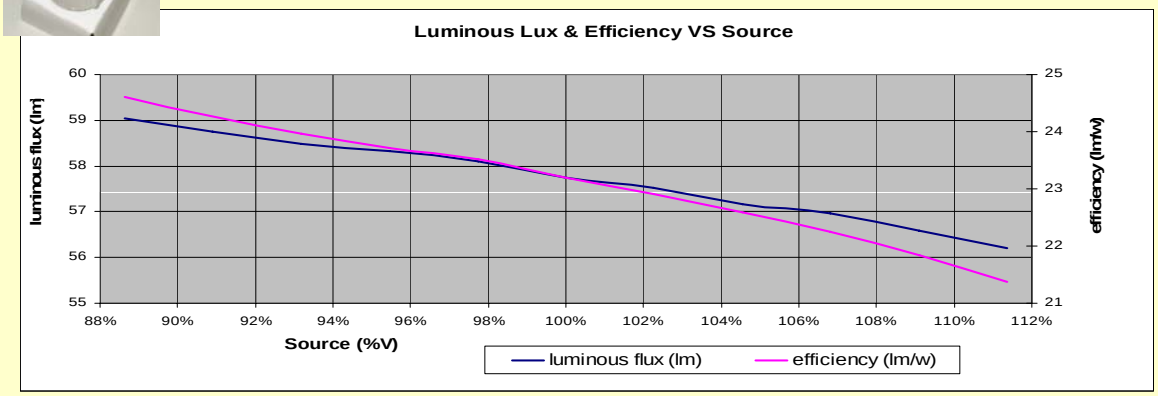
Lamp V1



Lamp D1



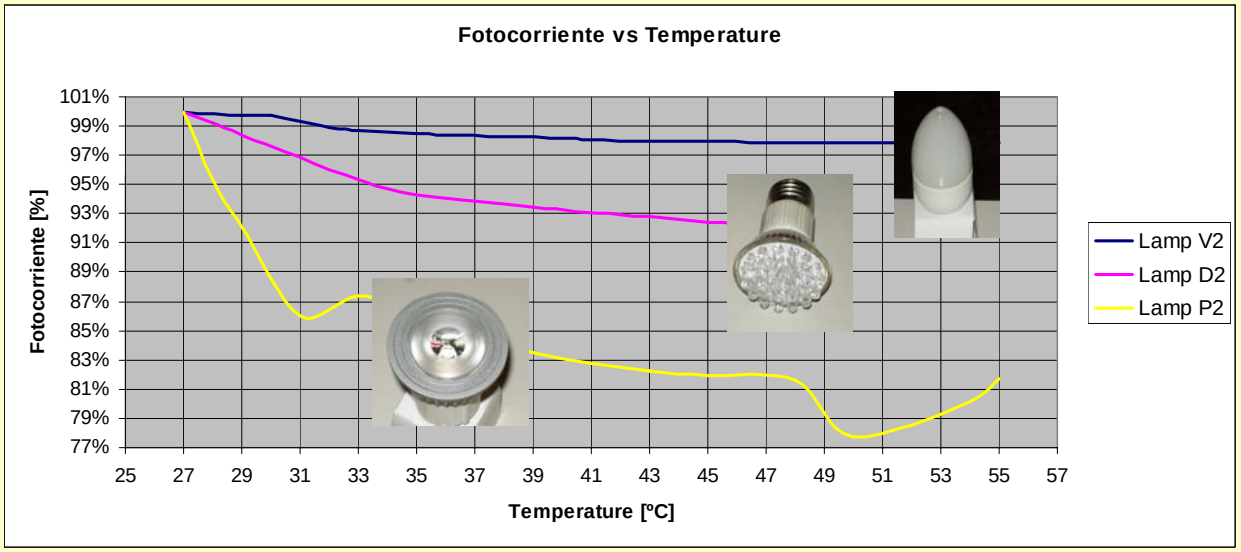
Lamp P2



Variation range

from -1% /2Volt to -1%/5Volt

Efficiency drops with temperature

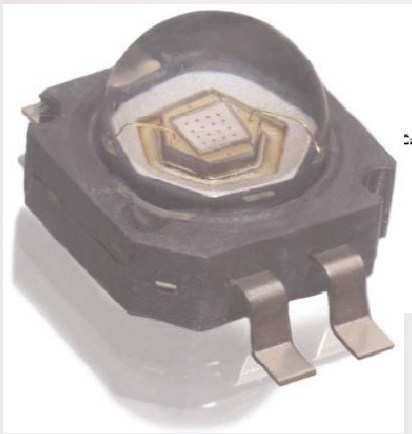


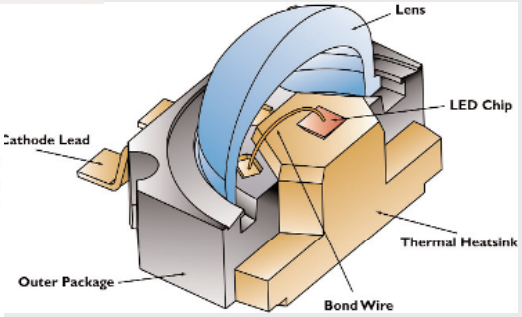
Variation range

from -1% /ºC to -0,25%/ºC

Heat removing seems to be present limitation to higer power densities. Heat afect both: lightin output and life.

Advanced LEDs are encapsulated with their own heatsinks



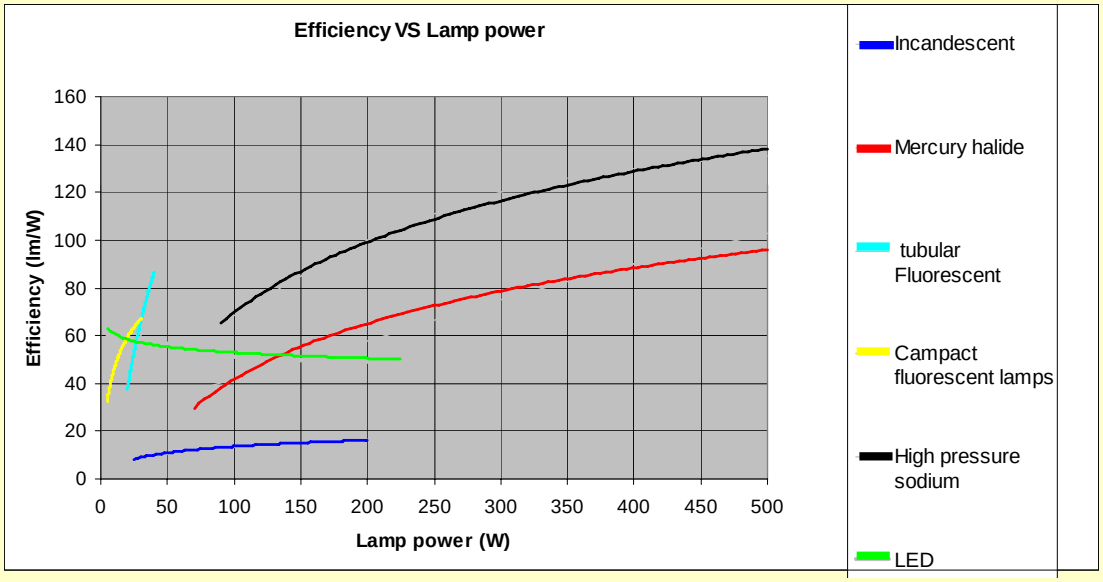


Source: Philips Lumileds

Efficiency drops with temperature

- A simple LED unit only account low power
- To get higher output, a number a LEDs are asambled in a board (LED array). Some luminaires account 1600 units.
- LED array may require better heat disipation: the higher the numbers of unit in the array, the higher temperature is and lower lumen output

LED array law: A LED isolated are more efficient than in an array. On the contrary: Conventional lamps increase efficiency with higher power



LED life and endurance

- One of the most promising aspects of LEDs is their long life (20.000 h to 70.000 h)
- Also, procedures for life evaluation seems to be a critical aspect in LED testing.
- At the present there are not any accepted procedure to asses LED life. However there are some proposals on tests.

LED life and endurance

- Useful life criterion
  - Luminous depreciation is the main component in LED life. As conventional lamps, depreciation of 50% (or 30% in some cases) of their luminous output determining the useful life of LEDs. The same criterion may be applicable for colour shift.
  - Based on this concept ASSIST (Alliance for Solid-State Illumination System and Technologies-Lighting Research Center – Rensselaer) proposes a 6.000 hours (10 month) test to assess lumen depreciation and colour shift. Useful life is obtained by the extrapolation on depreciation[1]
  - In our opinion lumen depreciation is not the only factor to determine LED life, endurance also account.

[1] ASSIST (Alliance for Solid-State Illumination System and Technologies-Lighting Research Center – Rensselaer) "LED Life for General Lighting" Vol 1, Issue 1,2 & 3. Feb.2005

LED life and endurance

- Endurance criterion
  - LED are sensitive to grid-transients. Over voltages/current may accelerate lighting depreciation or result in early failures.
  - A test under abnormal conditions, those commons of power supply is currently being developed to proof LED endurance.

Environmental aspects

- LED manufacturing implies less material and critical sustances and last longer than any other conventional lamps, therefore they impact less on the environment.

- Does LED light cause damages to human health? Although LED emits non-coherent radiation, further studies are carry on to ensure that in any cirumstances LED are not harmful to humans.

Risk assessment in lamps

IEC 60825-1

- Safety of laser product (include LEDs)

CIE DS 009

- Photobiological Safety of Lamps and Lamp System.

Aspects	IEC Standard	CIE Standard
Clasification	LED is considered as a laser	LED is considered as a lamp for general service
Definitions for source geometry	Smallest image in retina containing 63% of total power	Emmission of 50% of source output.
Pupil diameter to assess hazards	7 mm	A 200 mm
Action spectrum	No action spectrum for monocromatics sources	3 mm

Conclusions

- The development of apropiate measurement protocols and test procedures will help LED technology to get its maturity.
- Lack of Standard and lack of independent evaluation can distrust confidence of consumers on LED products (as it was the case of electronic ballasts). On the contrary, independent assessment and certification according standards, will shorten the time for the adoption of LED into the market.